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DESCRIPTION

METHOD AND APPARATUS FOR INTERMITTENT COMMUNICATION

5 Technical Field

The present invention relates to an intermittent communication on a wireless LAN (local area network).

Background Art

10 In a wireless LAN communication, a sleep mode may be used to reduce power consumption of a communication terminal. This technology is defined in ETSI TS 101 761-2 [5.2.6] (HiperLAN2) and ARIB STD-T70 [6.2.2.4] (HiSWANa).

More specifically, as shown in FIG.1, before a sleep  
 15 mode is entered, a communication terminal apparatus (MT) sends a sleep request to a communication terminal accommodation apparatus (AP) first. In response to the sleep request, the AP checks with the MT to see whether or not to start the sleep mode. After receiving a  
 20 confirmation of the sleep mode from the AP, the MT enters the sleep mode.

In the sleep mode, there are periods during which the MT checks a BCH (broadcast channel) and the MT checks the BCH at this timing and when there is uplink or downlink  
 25 data, the MT returns from the sleep mode to a normal mode and transmits/receives data. When there is no more data again, the MT enters the sleep mode using the above described procedure as required.

As in the case of an Internet telephone, when an application extends over not so wide a band and has isochronous data to be transmitted periodically, it is possible to achieve power saving by entering a sleep mode.

5 As shown in FIG.2, if a procedure such as a sleep request and confirmation is carried out every time, overhead 1101 necessary for the procedure increases, which causes a problem that the efficiency of power saving deteriorates due to the sleep mode and the next data communication  
10 starts before the sleep procedure is taken, thus preventing the sleep mode from being actually entered in the worst case.

#### Disclosure of Invention

15 It is an object of the present invention to provide an intermittent communication method and intermittent communication apparatus capable of reducing the rate of overhead necessary for a sleep mode starting procedure and improving the efficiency of power saving.

20 This object can be attained by setting a check period before entering an intermittent communication mode and once the intermittent communication mode is entered, transmitting/receiving data for the set period without taking a normal intermittent communication procedure and  
25 thereby reducing the rate of the overhead necessary for the intermittent communication procedure.

#### Brief Description of Drawings

FIG.1 illustrates an intermittent communication method;

FIG.2 illustrates a frame format according to a  
5 conventional intermittent communication method;

FIG.3 illustrates a frame format of an intermittent communication method according to the present invention;

FIG.4 is a block diagram showing a configuration of a communication terminal accommodation apparatus  
10 carrying out an intermittent communication method according to Embodiment 1 of the present invention;

FIG.5 is a block diagram showing a configuration of a communication terminal apparatus carrying out an intermittent communication method according to  
15 Embodiment 1 of the present invention;

FIG.6 is a block diagram showing another configuration of the communication terminal accommodation apparatus carrying out an intermittent communication method according to Embodiment 1 of the  
20 present invention;

FIG.7 is a block diagram showing another configuration of the communication terminal apparatus carrying out an intermittent communication method according to Embodiment 1 of the present invention;

FIG.8 is a block diagram showing a configuration of a communication terminal apparatus carrying out an intermittent communication method according to  
25 Embodiment 2 of the present invention;

FIG.9 is a block diagram showing a configuration of a communication terminal accommodation apparatus carrying out an intermittent communication method according to Embodiment 3 of the present invention;

5 Fig.10 is a block diagram showing a configuration of a communication terminal accommodation apparatus carrying out an intermittent communication method according to Embodiment 4 of the present invention; and

FIG.11 illustrates an intermittent communication method according to Embodiment 4 of the present invention.

Best mode for carrying out the invention

The present inventor et al. have noticed that as  
15 the count of a procedure for entering a sleep mode a plurality of times consecutively increases, the rate of an overhead portion necessary for the procedure increases and the efficiency of power saving thereby deteriorates. Then, the present inventor et al. have come up with the  
20 present invention by discovering that it is possible to improve the efficiency of power saving by determining the check period and sleep mode period before entering a sleep mode and reentering the sleep mode through an ignored process, that is, as shown in FIG.3, by determining  
25 a frame in which a data communication is carried out for the check period and the intermittent communication mode period in the overhead 101 when the sleep mode is entered, and then communicating data 102,103 only in the frame

in which the data communication is carried out through an ignored process.

The conventional sleep mode is a mode on standby until a communication becomes necessary when there is  
5 no data to be communicated. This requirement is based on a precondition that a sleep mode is entered one time in principle. The present invention is intended to realize continuous sleep (intermittent communication) by improving part of this requirement.

10 With reference now to the attached drawings, embodiments of the present invention will be explained in detail below.

(Embodiment 1)

15 FIG.4 is a block diagram showing a configuration of a communication terminal accommodation apparatus (AP) carrying out an intermittent communication method according to Embodiment 1 of the present invention.

An uplink signal transmitted from an MT is received  
20 by a radio reception section 202 through an antenna 201. The radio reception section 202 carries out predetermined radio reception processing (down-conversion and A/D conversion, etc.) on the uplink signal and outputs the signal subjected to the radio reception processing to  
25 a demodulation section 203.

The demodulation section 203 performs demodulation processing on the signal subjected to the radio reception processing and outputs received data. Furthermore, the

received data from the demodulation section 203 is output to a request confirmation section 204 and an identification information recognition section 205.

In response to an intermittent communication request sent from the MT, the request confirmation section 204 outputs a confirmation signal (result as to whether or not to accept the transition to the intermittent communication mode) to a packet generation section 206.

The identification information recognition section 205 recognizes identification information included in the intermittent communication request signal from the MT, that is, information on a check period or intermittent communication mode period, and frame information (number of frames, etc.) for carrying out a data communication and outputs this information on a check period or intermittent communication mode period, and frame information (number of frames, etc.) for carrying out a data communication to the packet generation section 206.

The packet generation section 206 inserts the confirmation signal into the intermittent communication request, generates a transmission packet and generates a transmission packet using transmission data. In this case, if the apparatus is in the intermittent communication mode, the packet generation section 206 generates a transmission packet according to the check period and intermittent communication mode period, and frame information (number of frames, etc.) for carrying

out a data communication included in the identification information. Furthermore, the packet generation section 206 outputs the transmission packet to a modulation section 207.

5           The modulation section 207 performs modulation processing on the transmission packet and outputs the modulated signal to a radio transmission section 208. The radio transmission section 208 carries out  
10       predetermined radio transmission processing (D/A conversion and up-conversion, etc.) on the modulated signal and sends the signal subjected to the radio transmission processing to the MT through the antenna  
201 as a downlink signal.

FIG.5 is a block diagram showing a configuration  
15       of a communication terminal apparatus (MT) carrying out an intermittent communication method according to Embodiment 1 of the present invention.

A downlink signal sent from the AP is received by a radio reception section 302 through an antenna 301.  
20       The radio reception section 302 carries out predetermined radio reception processing (down-conversion and A/D conversion, etc.) on the downlink signal and outputs the signal subjected to the radio reception processing to a demodulation section 303.

25           The demodulation section 303 carries out demodulation processing on the signal subjected to the radio reception processing and outputs received data. An identification information insertion section 305

outputs identification information indicating a check period in the intermittent communication mode and intermittent communication mode period, and frame information (number of frames, etc.) for carrying out  
5 a data communication to a packet generation section 306 based on, for example, the instruction information from a higher layer.

A sleep control section 304 exercises control of stopping the operations of the radio reception section  
10 302, demodulation section 303, packet generation section 306, modulation section 307 and radio transmission section 308 according to the identification information indicating a check period in the intermittent communication mode and intermittent communication mode  
15 period, and frame information (number of frames, etc.) for carrying out a data communication based on, for example, the instruction information from a higher layer.

The packet generation section 306 inserts the identification information which is information on a  
20 check period in the intermittent communication mode and intermittent communication mode period, and frame information (number of frames, etc.) for carrying out a data communication into transmission data and generates a transmission packet. In this case, if the apparatus  
25 is in the intermittent communication mode, the packet generation section 306 generates a transmission packet according to the check period and intermittent communication mode period, and frame information (number



of frames, etc.) for carrying out a data communication included in the identification information.

Furthermore, the packet generation section 306 outputs the transmission packet to the modulation section 307.

5           The modulation section 307 carries out modulation processing on the transmission packet and outputs the modulated signal to the radio transmission section 308. The radio transmission section 308 carries out predetermined radio transmission processing (D/A  
10 conversion and up-conversion, etc.) on the modulated signal and sends the signal subjected to the radio transmission processing to the MT through the antenna 301 as a downlink signal.

          The case where the intermittent communication of  
15 the present invention is carried out by the communication terminal accommodation apparatus and communication terminal apparatus in the above described configuration will be explained.

          First, the MT requests the AP to enter an  
20 intermittent communication mode. More specifically, the identification information insertion section 305 outputs the identification information which is information on a check period and intermittent communication mode period, and frame information (number  
25 of frames, etc.) for carrying out a data communication to the packet generation section 306 and the packet generation section 306 inserts the identification information into the transmission data (intermittent

communication request signal) and generates a transmission packet. Thus, the MT sends the transmission packet including the identification information to the AP as an intermittent communication request signal.

5       After demodulating the intermittent communication request signal from the MT, the AP checks the signal with the request confirmation section 204 and outputs a confirmation signal either accepting or not accepting the intermittent communication request to the packet  
10       generation section 206.

          Furthermore, the identification information recognition section 205 recognizes the identification information included in the demodulated intermittent communication request signal, that is, the check period  
15       in the intermittent communication mode, intermittent communication mode period, and frame information (number of frames, etc.) for carrying out a data communication and outputs the information to the packet generation  
          section 206.

20       The packet generation section 206 generates a transmission packet using a signal as to whether or not to accept the intermittent communication request which is a confirmation signal. The AP sends the transmission packet generated in this way to the MT as a confirmation  
25       signal in response to the intermittent communication request.

          The operations explained so far correspond to transmission/reception of the overhead 101 portion shown

in FIG.3 and the intermittent communication mode according to the present invention becomes effective hereafter.

In the intermittent communication mode, using the sleep control section 304 the MT exercises control of stopping the operations of the radio reception section 302, demodulation section 303, packet generation section 306, modulation section 307 and radio transmission section 308 during the sleep period shown in FIG.3. Furthermore, the sleep control section 304 checks the BCH based on the check period and controls, when there is data, transmission/reception of the data. At this time, the sleep control section 304 does not transmit/receive an intermittent communication request signal or confirmation signal as in the conventional case and checks the BCH using only a predetermined frame through an ignored process. The sleep control section 304 performs such control over the intermittent communication mode period.

Furthermore, the intermittent communication period preferably matches the same frame period as that of MAC broadcast. By matching the same frame period as that of MAC (sub) broadcast in the sleep mode with the intermittent communication period, it is possible to receive broadcast data taking advantage of the intermittent communication.

In this way, in the intermittent communication of the present invention, the procedure in the intermittent communication mode is carried out first, and from then on intermittent communications are carried out over an

intermittent communication mode period by checking the BCH (data communication) using only a specific frame for a predetermined check period through an ignored process. This avoids the necessity for carrying out a sleep starting  
5 procedure every time, and can thereby reduce the number of times intermittent communication request signals and confirmation signals necessary for the intermittent communication mode procedure are transmitted/received. As a result, it is possible to prevent deterioration in  
10 the efficiency of power saving due to overhead in the intermittent communication mode procedure.

More specifically, when a system whose one frame consists of 2 ms is applied to a speech communication, if 256 bits are assigned at a time, it is only necessary  
15 to perform transmission one time with two frames at 64 kbps, and therefore it is possible to use a time half that in a normal case for a sleep. Furthermore, in a 12 fps image communication, there are  $1/12 \text{ sec} = 83 \text{ msec}$  = approximately 42 frames, and therefore considering that  
20 a sleep takes place at  $2^n$  periods, it is only necessary to check every 32 frames, which results in considerable power saving.

Here, the identification information will be explained. The above described explanation refers to the  
25 case where the identification information is information on a check period in an intermittent communication mode and an intermittent communication mode period. Other examples of the identification information of the present

invention include (1) a bit indicating that a check is made at each check period followed by a sleep, (2) information indicating that there is a specified period different from a check period or a period for carrying out transmission/reception of data, (3) information on a predetermined frame when the BCH is checked at a check period followed by transmission/reception of data corresponding to the predetermined frame, (4) information on the specified period in (2) and the predetermined frame in (3).

Especially, the mode in which data corresponding to the predetermined frame is transmitted/received after a check as with (3) is preferable in the case where the amount of data is increased/decreased by the user's operation as in the case of Web access. Furthermore, it is also possible to check a normal intermittent communication mode and check period in the intermittent communication mode of the present invention, provide the check period with a meaning and notify the check period as identification information to thereby distinguish between the check period in the normal intermittent communication mode and check period in the intermittent communication mode of the present invention. In this case, it is possible to reduce the amount of identification information to be notified.

Furthermore, considering the necessity for checking a control channel (BCH) or other broadcast data, the intermittent communication period preferably matches the

period of the MAC broadcast frame. Furthermore, the identification information according to the intermittent communication method of the present invention preferably includes information on the number of frames used for communications. Assignment is normally performed once at X-frame periods, and therefore the number of frames need not be exchanged, but by adding information on the number of necessary frames, it is possible to perform assignment Y times at X-frame periods. This allows an intermittent communication when there are restrictions on communication resources that can be occupied in one-frame period or an intermittent communication with Ack.

The foregoing description refers to the case where identification information is inserted into an intermittent communication request signal from the MT, but according to the present invention it is also possible to insert identification information into a confirmation signal from the AP. This case will be explained below.

FIG.6 is a block diagram showing another configuration of the communication terminal accommodation apparatus (AP) carrying out the intermittent communication method according to Embodiment 1 of the present invention. In FIG.6, the same components as those in FIG.4 are assigned the same reference numerals as those in FIG.4 and detailed explanations thereof will be omitted.

The communication terminal accommodation apparatus

shown in FIG.6 is provided with an identification information insertion section 401 instead of the identification information recognition section 205. The identification information insertion section 401  
5 outputs identification information indicating a check period in an intermittent communication mode, intermittent communication mode period, and frame information (number of frames, etc.) for carrying out a data communication to a packet generation section 206  
10 based on, for example, instruction information from a higher layer.

The packet generation section 206 uses a signal as to whether or not to accept an intermittent communication request which is a confirmation signal and inserts  
15 identification information which is information on a check period in an intermittent communication mode and intermittent communication mode period, and frame information (number of frames, etc.) for carrying out a data communication into transmission data and generates  
20 a transmission packet.

FIG.7 is a block diagram showing another configuration of the communication terminal apparatus (MT) carrying out the intermittent communication method according to Embodiment 1 of the present invention. In  
25 FIG.7, the same components as those in FIG.5 are assigned the same reference numerals as those in FIG.5 and detailed explanations thereof will be omitted.

The communication terminal apparatus shown in FIG.7

is provided with an identification information recognition section 501 instead of the identification information insertion section 305. The identification information recognition section 501 recognizes

5 identification information included in a confirmation signal from the AP, that is, information on a check period and intermittent communication mode period, and frame information (number of frames, etc.) for carrying out a data communication and outputs the information on this

10 check period and intermittent communication mode period, and frame information (number of frames, etc.) for carrying out a data communication to a sleep control section 304 and packet generation section 306.

In an intermittent communication mode, the packet

15 generation section 306 generates a transmission packet according to the check period and intermittent communication mode period, and frame information (number of frames, etc.) for carrying out a data communication included in the identification information.

20 Furthermore, the sleep control section 304 performs sleep control according to the identification information.

The case where the intermittent communication of the present invention is carried out using the communication terminal accommodation apparatus and

25 communication terminal apparatus in the above described configurations will be explained.

First, the MT requests the AP to enter an intermittent communication mode. That is, the MT sends



the transmission packet generated at the packet generation section 306 to the AP as an intermittent communication request signal.

5 After demodulating the intermittent communication request signal from the MT, the request confirmation section 204 of the AP checks the request signal and outputs a signal as to whether or not to accept the intermittent communication request to the packet generation section 206.

10 The packet generation section 206 generates a transmission packet using a signal either accepting or not accepting the intermittent communication request. Furthermore, the identification information insertion section 401 outputs identification information which is  
15 information on the check period and intermittent communication mode period, and frame information (number of frames, etc.) for carrying out a data communication to the packet generation section 206 according to the instruction information from a higher layer indicating  
20 that the intermittent communication mode should be entered and the packet generation section 206 inserts identification information into the confirmation signal to generate a transmission packet. The AP sends the transmission packet generated in this way to the MT as  
25 a confirmation signal in response to the intermittent communication request.

The identification information recognition section 501 of the MT recognizes identification information

included in the demodulated confirmation signal, that is, the check period in the intermittent communication mode, intermittent communication mode period, and frame information (number of frames, etc.) for carrying out  
5 a data communication and outputs the information to the sleep control section 304 and packet generation section 306.

The operations explained so far correspond to transmission/reception of the overhead 101 portion shown  
10 in FIG.3 and the intermittent communication mode of the present invention becomes effective hereafter.

In the intermittent communication mode, the sleep control section 304 of the MT exercises control of stopping the operations of the radio reception section 302,  
15 demodulation section 303, packet generation section 306, modulation section 307 and radio transmission section 308 during the sleep period shown in FIG.3. Furthermore, the sleep control section 304 checks the BCH based on the check period and controls, when there is data,  
20 transmission/reception of the data. At this time, the sleep control section 304 performs no transmission/reception of the intermittent communication request signal or confirmation signal as in the conventional case and performs a BCH check through  
25 an ignored process. The sleep control section 304 exercises such control over the intermittent communication mode period.

In this way, also when the identification

information is inserted into the confirmation signal sent from the AP to the MT, the procedure in the intermittent communication mode is carried out first, and from then on intermittent communications are carried out over an intermittent communication mode period by only checking the BCH for a predetermined check period through an ignored process. This eliminates the necessity for carrying out the sleep starting procedure every time, and can thereby reduce the number of times intermittent communication request signals necessary for the intermittent communication mode procedure and confirmation signals are transmitted/received. As a result, it is possible to prevent deterioration in the efficiency of power saving due to overhead in the intermittent communication mode procedure.

(Embodiment 2)

This embodiment will describe a case where control channels (e.g., BCH) are not checked either in the intermittent communication mode of the present invention within a range in which synchronization can be maintained. In this case, the intermittent communication mode period according to this embodiment needs to be set to a period shorter than a maximum allowable synchronization holding time. In this way, the MT even need not check the BCH and can perform power saving more efficiently through an intermittent communication.

In this case, when synchronization can no longer

be held due to factors such as disturbance even within the maximum allowable synchronization holding time, it is necessary to return to a normal mode and reset the intermittent communication mode period. Such a case will  
5 be explained below.

FIG.8 is a block diagram showing a configuration of a communication terminal apparatus carrying out an intermittent communication method according to Embodiment 2 of the present invention. In FIG.8, the same  
10 components as those in FIG.5 are assigned the same reference numerals as those in FIG.5 and detailed explanations thereof will be omitted.

The communication terminal apparatus shown in FIG.8 is provided with a synchronization holding state  
15 confirmation section 601 that checks to see whether synchronization can be held or not. This synchronization holding state confirmation section 601 checks whether synchronization of the MT can be held or not based on a received signal and outputs the confirmation result  
20 (e.g., information that a synchronization holding state can no longer be held) to an identification information insertion section 305 and a sleep control section 304. The synchronization holding state can be checked using a known method.

25 In the intermittent communication mode according to this embodiment, the BCH which is a control channel is not checked, and only data is transmitted/received periodically at specified periods. At this time, the

synchronization holding state confirmation section 601 checks the synchronization holding state using the received signal. When it is decided that the synchronization holding state cannot be held, the  
5 synchronization holding state confirmation section 601 outputs a control signal indicating the fact to the identification information insertion section 305 and sleep control section 304.

The sleep control section 304 selects the normal  
10 intermittent communication mode according to the control signal indicating that the synchronization holding state cannot be held and performs sleep control in the intermittent communication mode. Furthermore, the identification information insertion section 305 resets  
15 the intermittent communication mode period according to the control signal indicating that the synchronization holding state cannot be held and outputs the intermittent communication mode period to the packet generation section 306 as identification information.

20 The subsequent processing is the same as that in Embodiment 1 described above.

Thus, according to this embodiment, the MT even need not check the BCH and can perform power saving through an intermittent communication efficiently. Furthermore,  
25 even if the synchronization holding state cannot be held, it is possible to reset the intermittent communication mode period and carry out an intermittent communication of the present invention.

In the above described explanations, the intermittent communication mode period is set to a period shorter than a maximum allowable synchronization holding time, but in the case where the intermittent communication mode period is longer than the maximum allowable synchronization holding time, it is preferable to receive a control channel signal for correcting the state out of synchronization with the AP periodically and correct the out-of-synchronization state based on the control channel signal for correcting the out-of-synchronization state. This makes it possible to realize an intermittent communication according to the present invention irrespective of the maximum allowable synchronization holding time.

Furthermore, in the intermittent communication mode period, it is preferable for the MT to receive a control channel signal for periodically checking the control of the AP. When the AP desires to change a parameter of an intermittent communication, the MT checks it periodically, and can thereby flexibly respond to variations in the traffic situation, etc. The effects are especially large when control channels and broadcast data are not received.

(Embodiment 3)

This embodiment will describe a case where identification information such as a check period is reset when traffic increases in the intermittent communication mode of the present invention.

FIG.9 is a block diagram showing a configuration of a communication terminal accommodation apparatus carrying out an intermittent communication method according to Embodiment 3 of the present invention. In  
5 FIG.9, the same components as those in FIG.6 are assigned the same reference numerals as those in FIG.6 and detailed explanations thereof will be omitted.

The communication terminal accommodation apparatus shown in FIG.9 is provided with a traffic monitoring  
10 section 701 that monitors the traffic congestion state. This traffic monitoring section 701 monitors whether traffic is busy or not based on a received signal and outputs a control signal indicating that identification information such as a check period should be reset to  
15 an identification information insertion section 401. Here, traffic can be monitored using a known method.

In the intermittent communication mode of this embodiment, the traffic monitoring section 701 monitors traffic using a received signal. When the traffic  
20 monitoring section 701 decides that it is necessary to reset identification information such as the check period because of an increase in traffic, the traffic monitoring section 701 outputs a control signal indicating the information to the identification information insertion  
25 section 401.

The identification information insertion section 401 resets identification information such as a check period according to the control signal indicating that

the identification information needs to be reset and outputs the identification information to the packet generation section 206.

The subsequent processing is the same as that in  
5 Embodiment 1.

As shown above, this embodiment can perform power saving using an intermittent communication even when traffic increases.

10 (Embodiment 4)

This embodiment will describe a case where the period of an intermittent communication is set to once every  $2^n$  frames ( $n$ : natural number) and an intermittent communication is carried out by bringing together  
15 applications (services) with a plurality of periods and in a form including all the corresponding periods.

FIG.10 is a block diagram showing a configuration of a communication terminal accommodation apparatus carrying out an intermittent communication method  
20 according to Embodiment 4 of the present invention. In FIG.10, the same components as those in FIG.6 are assigned the same reference numerals as those in FIG.6 and detailed explanations thereof will be omitted.

The communication terminal accommodation apparatus  
25 shown in FIG.10 is provided with a service control section 801 that controls a plurality of applications (services). The service control section 801 controls identification information such as the respective check periods, etc.



of the plurality of services #1 to #n (e.g., speech, keyboard, image (mpeg), etc.) and outputs the identification information to an identification information insertion section 401. The identification information insertion section 401 associates the  
5 identification information on the check period, etc. determined by the service control section 801 with each MT and outputs the identification information to a packet generation section 206.

10           The subsequent processing is the same as that in Embodiment 1.

When the MT sleeps based on the identification information determined by the service control section 801, the MT has a check period of a pattern as shown in  
15 FIG.11. In FIG.11, white bullets denote timings at which the MT checks. The pattern shown in FIG.11 can be expressed by representing the value of n of  $2^n$  which is a synchronization parameter using a bit string.

According to this embodiment, even when a plurality  
20 of services is handled in a communication, it is possible to efficiently cause each MT to sleep and efficiently carry out an intermittent communication, and the AP can also be associated with each MT using  $2^n$ , and therefore it is possible to realize an efficient communication.

25

(Embodiment 5)

This embodiment will describe a case where retransmissions are enabled. When a plurality of frames

is available, an intermittent communication according to this embodiment realizes an ARQ (Automatic Repeat Request) by securing Ack/Nack frames, automatically adding, when the AP sends Nack, a frame for retransmission and carrying out communications continuously.

Thus, according to this embodiment, it is possible to enable retransmissions in an intermittent communication mode, prevent a standby state until the next timing of intermittent communication before it is too late, and immediately communicate using the next frame and increase data which can be rescued by retransmissions. As a result, it is possible to reduce the probability of discarding packets and improve the transmission efficiency. This embodiment is particularly effective for Web access, etc.

The present invention is not limited to above described Embodiments 1 to 5 but can be implemented modified in various ways. Furthermore, Embodiments 1 to 5 can also be combined as appropriate. For example, it is also possible to construct a radio communication system using the communication terminal apparatus and communication terminal accommodation apparatus in the above described explanations.

Furthermore, the above described intermittent communication method can also be constructed by software. That is, the intermittent communication method can be constructed of an intermittent communication program that causes a computer to execute a step of transmitting

identification information including an intermittent communication period and frame information for carrying out a data communication together with an intermittent communication request from a communication terminal apparatus to a communication terminal accommodation apparatus, a step of the communication terminal accommodation apparatus transmitting a confirmation signal of the intermittent communication request to the communication terminal apparatus, a step of the communication terminal apparatus entering an intermittent communication mode, when the communication terminal apparatus receives the confirmation signal and carrying out a data communication only using the frame for carrying out the data communication in the intermittent communication mode, or constructed of an intermittent communication program that causes a computer to execute a step of transmitting an intermittent communication request from the communication terminal apparatus to the communication terminal accommodation apparatus, a step of the communication terminal accommodation apparatus transmitting a confirmation signal of the intermittent communication request together with identification information including an intermittent communication period and frame information for carrying out a data communication to the communication terminal apparatus and a step of the communication terminal apparatus entering the intermittent communication mode when the communication terminal

apparatus receives the confirmation signal and carrying out a data communication only using the frame for carrying out the data communication in the intermittent communication mode. In this case, it is also possible to achieve effects similar to those when the intermittent communication method is implemented by hardware.

As described above, the intermittent communication method and intermittent communication apparatus of the present invention are applicable to a communication terminal apparatus and communication terminal accommodation apparatus in a radio communication.

The intermittent communication method of the present invention comprises a step of transmitting identification information including an intermittent communication period and frame information for carrying out a data communication together with an intermittent communication request from a communication terminal apparatus to a communication terminal accommodation apparatus, a step of the communication terminal accommodation apparatus transmitting a confirmation signal of the intermittent communication request to the communication terminal apparatus and a step of the communication terminal apparatus entering an intermittent communication mode when the communication terminal apparatus receives the confirmation signal and carrying out a data communication using only the frame for carrying out the data communication in the intermittent communication mode.

According to this method, a check period is preset before entering the intermittent communication mode, and once the intermittent communication mode is entered, data is transmitted/received with a predetermined frame in the set period without a normal intermittent communication procedure, and therefore it is possible to reduce the rate of overhead necessary for the intermittent communication procedure and improve the efficiency of power saving through the intermittent communication.

The intermittent communication method of the present invention comprises a step of transmitting an intermittent communication request from a communication terminal apparatus to a communication terminal accommodation apparatus, a step of the communication terminal accommodation apparatus transmitting a confirmation signal of the intermittent communication request together with identification information including an intermittent communication period and frame information for carrying out a data communication to the communication terminal apparatus and a step of the communication terminal apparatus entering an intermittent communication mode when the communication terminal apparatus receives the confirmation signal and carrying out a data communication with only the frame carrying out the data communication in the intermittent communication mode.

According to this method, when an intermittent

communication mode is entered, a check period is preset and once the intermittent communication mode is entered, data is transmitted/received with a predetermined frame in the set period without any normal intermittent  
5 communication procedure, and therefore it is possible to reduce the rate of overhead necessary for the intermittent communication procedure and improve the efficiency of power saving through an intermittent communication.

10 In the intermittent communication method of the present invention, the identification information includes information on the number of frames used for a communication.

Assignment is normally performed once at X-frame  
15 periods, and therefore the number of frames need not be exchanged, but by adding information on the number of necessary frames, it is possible to perform assignment Y times X-frame periods. This allows an intermittent communication when there are restrictions on the  
20 communication resources that can be occupied in one-frame period or an intermittent communication with Ack for an ARQ which comes later.

In the intermittent communication method of the present invention, the intermittent communication period  
25 matches the period of the same frame as that of MAC broadcast.

According to this method, matching the same frame as that of MAC (sub) broadcast in a sleep mode with the

intermittent communication period makes it possible to also receive broadcast data while carrying out an intermittent communication.

5       The intermittent communication method of the present invention is characterized in that the communication terminal apparatus does not receive any control channel signal in a data communication in the intermittent communication mode.

10       The intermittent communication method of the present invention is characterized in that the intermittent communication mode period is shorter than a maximum allowable synchronization holding time of the communication terminal apparatus.

15       According to these methods, even the control channel need not be checked, making it possible to perform power saving through an intermittent communication more efficiently.

20       The intermittent communication method of the present invention is characterized in that when the intermittent communication mode period is longer than the maximum allowable synchronization holding time, the communication terminal apparatus receives a control channel signal to correct an out-of-synchronization state.

25       According to these methods, it is possible to realize an intermittent communication avoiding a control channel check whenever possible irrespective of the maximum allowable synchronization holding time.

The intermittent communication method of the present invention is characterized in that the communication terminal apparatus receives a control channel signal for periodically checking the control of the communication terminal accommodation apparatus in the intermittent communication mode period.

According to this method, when the communication terminal accommodation apparatus desires to change an intermittent communication parameter, the communication terminal apparatus checks the parameter periodically, and can thereby flexibly respond to variations in the traffic situation, etc. Effects are large especially when no control channel or broadcast data is received.

In the intermittent communication method of the present invention, a retransmission frame is added when the communication terminal apparatus receives a Nack signal from the communication terminal accommodation apparatus.

According to this method, it is possible to enable retransmissions in the intermittent communication mode, suppress an increase in the delay caused by standby until the next timing of intermittent communication and immediately communicate using the next frame and increase data that can be rescued by retransmissions. As a result, it is possible to reduce the probability of discarding packets and improve the transmission efficiency.

The intermittent communication method of the present invention is characterized in that the



intermittent communication period is set to once every  $2^n$  frames ( $n$ : natural number) and an intermittent communication is performed by patterning applications with a plurality of periods.

5           According to this method, even when a plurality of applications (services) is handled in a communication, it is possible to efficiently cause each communication terminal apparatus to sleep, efficiently carry out an intermittent communication, also allow the communication  
10 terminal accommodation apparatus to respond to each communication terminal apparatus once every  $2^n$  frames and thereby perform a communication efficiently.

          The communication terminal apparatus of the present invention comprises an intermittent communication  
15 apparatus provided with an identification information insertion section that inserts identification information including an intermittent communication period and frame information for carrying out a data communication into transmission data and a control  
20 section that performs control, when a confirmation signal in response to an intermittent communication request is received from the communication terminal accommodation apparatus, in such a way that the data communication is carried out based on the intermittent communication  
25 period and frame information for carrying out a data communication using only the frame for carrying out the data communication.

          According to this configuration, a check period is

preset before entering an intermittent communication mode,  
and once the intermittent communication mode is entered,  
data is transmitted/received with a predetermined frame  
in the set period without a normal sleep starting procedure,  
5 and therefore it is possible to reduce the rate of overhead  
necessary for the intermittent communication procedure  
and improve the efficiency of power saving through an  
intermittent communication.

The communication terminal accommodation apparatus  
10 of the present invention comprises a reception section  
that receives an intermittent communication request from  
the communication terminal apparatus, a transmission  
section that transmits a confirmation signal of the  
intermittent communication request and identification  
15 information including an intermittent communication  
period and frame information for carrying out a data  
communication to the communication terminal apparatus  
and a control section that carries out a data communication,  
when the communication terminal apparatus enters an  
20 intermittent communication mode, using only the frame  
for carrying out the data communication in the  
intermittent communication mode.

According to this configuration, a check period is  
preset before entering an intermittent communication mode,  
25 and once the intermittent communication mode is entered,  
data is transmitted/received with a predetermined frame  
in the set period without a normal sleep starting procedure,  
and therefore it is possible to reduce the rate of overhead

necessary for the intermittent communication procedure and improve the efficiency of power saving through an intermittent communication.

The radio communication system of the present invention is a radio communication system comprising a plurality of communication terminal apparatuses and a communication terminal accommodation apparatus that accommodates these communication terminal apparatuses, wherein the communication terminal apparatus comprises an intermittent communication apparatus provided with an identification information insertion section that inserts an intermittent communication period and identification information including frame information for carrying out a data communication into transmission data and a control section that controls for carrying out a data communication, when a confirmation signal in response to an intermittent communication request is received from the communication terminal accommodation apparatus, using only the frame for carrying out the data communication based on the intermittent communication period and frame information for carrying out a data communication, and the communication terminal accommodation apparatus comprises an intermittent communication apparatus provided with a reception section that receives an intermittent communication request from the communication terminal apparatus, a transmission section that transmits a confirmation signal of the intermittent communication request together with

identification information including an intermittent communication period and frame information for carrying out a data communication and a control section that carries out a data communication, when the communication terminal apparatus enters an intermittent communication mode, using only the frame for carrying out the data communication in the intermittent communication mode.

According to this configuration, a check period is preset before entering an intermittent communication mode, and once the intermittent communication mode is entered, data is transmitted/received with a predetermined frame in the set period without a normal sleep starting procedure, and therefore it is possible to reduce the rate of overhead necessary for the intermittent communication procedure and improve the efficiency of power saving through an intermittent communication.

The intermittent communication program of the present invention is to cause a computer to execute a step of transmitting identification information including an intermittent communication period and frame information for carrying out a data communication together with an intermittent communication request from a communication terminal apparatus to a communication terminal accommodation apparatus, a step of the communication terminal accommodation apparatus transmitting a confirmation signal of the intermittent communication request to the communication terminal apparatus and a step of the communication terminal

apparatus entering an intermittent communication mode when the communication terminal apparatus receives the confirmation signal and carrying out the data communication using only the frame for carrying out the data communication in the intermittent communication mode.

According to this program, a check period is preset before entering an intermittent communication mode, and once the intermittent communication mode is entered, data is transmitted/received with a predetermined frame in the set period without a normal sleep starting procedure, and therefore it is possible to reduce the rate of overhead necessary for the intermittent communication procedure and improve the efficiency of power saving through an intermittent communication.

The intermittent communication program of the present invention is to cause a computer to execute a step of transmitting an intermittent communication request from a communication terminal apparatus to a communication terminal accommodation apparatus, a step of the communication terminal accommodation apparatus transmitting a confirmation signal of the intermittent communication request together with identification information including an intermittent communication period and frame information for carrying out a data communication to the communication terminal apparatus and a step of the communication terminal apparatus entering an intermittent communication mode when the

communication terminal apparatus receives the confirmation signal and carrying out a data communication using only the frame for carrying out the data communication in the intermittent communication mode.

5           According to this program, a check period is preset before entering an intermittent communication mode, and once the intermittent communication mode is entered, data is transmitted/received with a predetermined frame in the set period without a normal sleep starting procedure,  
10           and therefore it is possible to reduce the rate of overhead necessary for the intermittent communication procedure and improve the efficiency of power saving through an intermittent communication.

          As described above, according to the present  
15           invention, a check period is preset before entering an intermittent communication mode, and once the intermittent communication mode is entered, data is transmitted/received with a predetermined frame in the set period without a normal sleep starting procedure,  
20           and therefore it is possible to reduce the rate of overhead necessary for the intermittent communication procedure and improve the efficiency of power saving through an intermittent communication.

25           This application is based on the Japanese patent application No.2001-305740 filed on October 1, 2001, entire content of which is expressly incorporated by reference herein.

Industrial applicability

The present invention is preferably applicable to a wireless LAN (local area network).